Case Study

Network Rail

Grinding Train Fleet

2013 - 2014

IT4Automation's ethernet network refit provides Network Rail with increased operational efficiency at reduced cost – a true platform for change!

Challange

- Enhance Grinding Train Fleet's reputation for a highly reliable service
  - A reduction in 'lost shifts'
  - Increase control network reliability
  - Reduce track maintenance activity
- Compliant with EN50155 standard

Environment

- 7 Carriage Consist
- High electromagnetic interference
- Significant Vibration
- Dirty Atmosphere
- Restricted Space
- Limited Access Periods

IT4A Solution

- Zero service impacting network communication failures
- Automated millisecond network failover to multiple alternate data paths
- EN-50173 Copper Infrastructure Certification
- M12, D-Coded Connectors
- Remote Condition Monitoring, Remote Access and Remote Diagnostics
- EN50155 standard met throughout

Background

Network Rail's Grinding Train Fleet plays a fundamental role in maintaining the rail infrastructure of the UK, ensuring that passengers enjoy a safe, comfortable and reliable journey, as well as reducing noise for rail-side residents.

The Grinding Train Fleet extends the life of the UK's rail track through renovation rather than replacement. This approach results in huge savings in operating costs and in minimising the disruption of passenger services. Three vehicles have the task of keeping 22,000 miles of UK track in good shape with each Grinding Train running on a tight schedule to reprofile 6,000 miles of track each year. The consequence of a lost shift is considerable both in cost and in the damage caused to Network Rail's reputation. If a shift is lost, the opportunity to reprofile the affected section of track is lost, possibly for years! It is, therefore, essential that these grinding trains are maintained to the highest standard.

Systems that support the rail grinding service need to be fit for purpose, robust and regularly maintained to achieve the high availability that is demanded. EN-50155 is an International standard that enforces such performance criteria for on-board rolling-stock systems.

When these Grinding Train vehicles were introduced, the idea of an EN50155 rail certified active ethernet switch with millisecond failover was not close to realisation. Due to the limited options in product selection available at the time, the Grinding Train on-board network comprised products typically found in a small office. Whilst offering connectivity, this legacy infrastructure failed to offer network resilience, robustness or optimum management. The communication issues that relate to this type of legacy infrastructure result in frequent failures that are intermittent, that impact badly on service and that are always hard to diagnose or to resolve.

In 2013, Network Rail's Grinding Train Fleet manager Leevan Finney, identified that increasing numbers of 'on vehicle' issues, including system blackouts, were network related issues; they were causing disruption to planned engineering works and, by association, the Fleet's reputation. It was crucial to find a replacement network automation solution that could withstand harsh environmental factors and return reliable operation to the Grinding Train Fleet.

IT4A has been delivering network solutions to light and heavy automation industries for more than fifteen years. In 1999 we completed an offshore project for British Gas in Morecambe Bay, upgrading the offshore and onshore communications infrastructure. The same exacting standards have since been applied to projects across a wide variety of industries, including building management; water and water treatment; steel production; transportation (road and marine); oil and gas and, in the past 12 months, nuclear energy. IT4A's first involvement in on vehicle rail infrastructure was in 2011/2012 where a 3G remote RTU monitoring solution was implemented and operated for KnorrBremse.

Since 2006, IT4A has been a primary and certified distribution partner of automation networking vendor, MOXA. This relationship is being further enhanced as IT4A becomes the UK's only MOXA accredited training provider. To complement supply only, IT4A have the capability, with a proven track record, to deliver turnkey project solutions with ongoing service and technical support. It is this unique combination that sets IT4A apart; it is why Network Rail selected IT4A.

> **" It is IT4A's broad experience, from connector to the application service, that allows challenges such as these to be accepted and solutions delivered - irrespective of industry. "**

John French,
Managing Director, IT4A

The Grinding Train Fleet Network Challenge

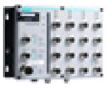
Quite clear really… to provide the Grinding Train Fleet with a self-healing, auto-alerting, fit-for-purpose, EN50155 certified network infrastructure that wouldn't fail in service. This goal had to be achieved within an environment where cables, connectors and power sources have historically been identified as weaknesses. Ideally, the new system needed to communicate and service related data to a centralised monitoring system where remediation could be prioritised and actioned.

LEGEND

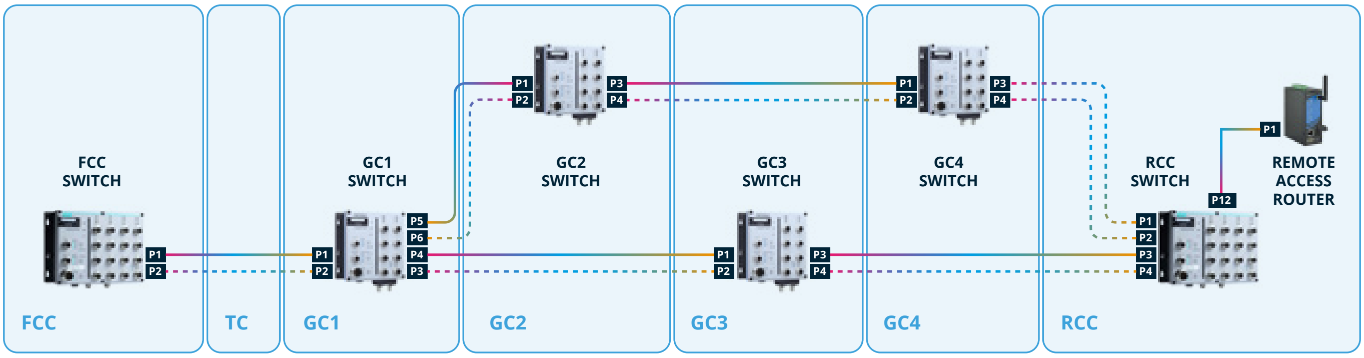
ACTIVE PATH(S) ———

BACKUP PATH(S) - - - - -

MOXA TN-5516 ETHERNET SWITCH



NETWORK AS BUILT DIAGRAM



The Approach

The topology and resilience of the active ethernet network is always constrained, to an extent, by the underlying cable connectivity. In this case IT4A had access to: 7 x CAT5e copper cables extended between carriages across a rugged umbilical interconnection.

For new challenges, IT4A's 'ground- (or, in this case, track-)up' approach is integral to the success of a project. This starts with a physical review of cable, connector and containment path, combined with a detailed certification record for each cable, creating an essential reference resource and, if relevant, a clear line of supplier demarcation. With an appropriate topology defined, the related network features are configured to achieve the desired connectivity, network resilience and control of data paths across the network.

Finally, the networks management, monitoring and alerting features are configured to relay service- critical events back to a remote condition monitoring system, in this case, located at IT4A's network operations centre in Epsom, Surrey. The train-to-ground communications infrastructure for network automation systems is also provided by IT4A. This secure, remote condition monitoring system allows on-board services to benefit from shared network monitoring services such as email relay, synchronised network time, system wide event logging and antivirus as well as a host of other monitoring and system support services.

> **" Taking the time to visit the vehicle, understand the environment and learn the consequence of communication failure paid dividends. "**

> **" It was clear from the harsh environment that failures in the communication path could be minimised through design but probably not eradicated. A network design, able to accommodate component failure without service disruption, was therefore required. "**

John French,
Managing Director, IT4A

The IT4A Solution

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Custom made cabling work tested and certified bu IT4A

Passive Infrastructure

Our certification of newly installed data cables identified issues that, if left unchecked, would compromise the reliability of any new network that used them. Rather than hand these issues back to the customer, IT4A took on the challenge to solve the network infrastructure problem. The investigation and analysis which followed identified issues with cable termination, network infrastructure design and connector selection.

IT4A's final solution involved a reduction in the number of connections, improvements in the quality of terminations and the adoption of M12 connectors designed for data. The enhancements resulted in a vehicle-wide, copper cabling system which is able to pass the EN-50173 infrastructure certification standard that reliable, high speed, active ethernet networks demand.

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Moxa TN-5518A EN50155 16+2G-port managed ethernet switches

Active Ethernet

Beyond product selection, IT4A's aim was to build as much resilience as possible into the inter-vehicle/car/carriage communication path; a known weakness. The new network design benefits from triple redundancy in the data path with automated sub second failover. Another system weakness is often the failure of the power source. In this case, each switch is powered from both AC and 48VDC local supplies. The active network is now more robust than the connecting PLCs that communicate across it. IT4A selected the EN50155 certified MOXA TN range of active ethernet switches and the MOXA OnCell Train-to-Ground Routing devices to deliver the form, fit and functions required.

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Moxa On-Cell 5014HSPA

Monitoring & Management

Network resilience is only really useful if there is a mechanism to alert when a failure occurs, otherwise all that is achieved is greater periods of time between failures. Having installed a On-Cell 5014HSPA, IT4A is able to provide a 24/7 network monitoring service to capture such events and initiate a relevant remediation plan. These services also provide customers with automated alerts on degraded operation and failure. As a result of this network monitoring service, the objective for an on-board network to operate at 100% availability at the beginning of each shift is now a reality.

Real time network status is now available to Grinding Train Fleet maintenance and fleet management teams through a graphical representation which can be viewed, if allowed, from anywhere in the world.

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Moxa V2616A-C5-LX

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AWK 3131 RCC Series

" ...the knowledge and willing were delivered in ample amounts along with a comparative price, IT4A have helped us to get out of some difficult areas... "

" Since the upgrade was completed in March 2014 there has been an increase in the performance of all of the on-board systems and no reported network downtime. "

Leevan Finney,
Fleet Engineer, Network Rail

The Next Steps

Secure remote access to on-board network systems is going to be extended to Grinding Train Fleet maintenance staff and also to an OEM. This becomes particularly useful as the OEM is based in the US, where significant delays and costs sometimes result from minor system changes or upgrades.

Implementing remote condition monitoring systems onto each vehicle will enable the status of, not only the network devices to be monitored, but also connected devices (PCs etc).

The addition of an intelligent, locally installed, MOXA V2616A-C5-LX, EN50155 compliant computing platform on-board the train/vehicle will enable new opportunities to collect, trend and present new data and alerts that are not currently accessible from engine management systems.

Historically, engineers had to wire their laptops directly into the control network to service local systems. In this instance, running wires is inflexible and often poses a trip hazard. As well as the practical confines, the direct connection of a laptop introduces a backdoor for viruses to cross into the control system PCs. To overcome these issues IT4A will be implementing a secure wireless access system allowing all connections to pass through a firewalled interface. This eliminates connection issues and significantly reduces the chance of virus transfer. The product selected here was the EN50155 certified MOXA AWK 3131 RCC Series

This will add a new level of network reliability and availability to the Grinding Train Fleet, reduce operating costs and further enhance Network Rail's reputation with their customers.

" Increased resilience has also reduced the 'no fault found' scenario and reduced investigatory maintenance cost to zero. "

Leevan Finney, Fleet Engineer, Network Rail

To find out more about how IT4A can help solve your networking problems, whether it is on-board, wayside or train-to-ground then get in touch.

T: 08707 104 060
E: sales@it4automation.com

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